

CLAIMS (as originally filed and published)

1. A method for acquiring optical near-field interaction signals in the infrared spectral region, comprising the steps of:
 - illumination of an object combination comprising at least two objects (1-7) with infrared radiation so that an infrared near-field coupling is generated between the objects (1-7); and
 - acquisition the scattered light which is scattered by the object combination, which scattered light comprises a fraction (s) that has been modified as a result of the near-field coupling,
characterised in that
 - at least one of the objects (1-7) comprises a polar material which at least in part comprises a polar solid-state structure; and
 - during illumination in at least one of the objects (1-7) with the polar material at least one phonon resonance is excited with which the modified fraction (s) of the scattered light is strengthened.
2. The method according to claim 1, in which acquiring the modified fraction (s) comprises infrared detection with a detector device (40).
3. The method according to claim 2, in which one of the objects which forms a sample (1) comprises a solid-state surface, an adsorbate on a solid-state surface, or a solid, liquid or gaseous volume material.
4. The method according to claim 2 or 3, in which one of the objects which forms a probe (2) comprises a scanning tip of a near-field microscope, a reading

head or at least one particle embedded, or suspended in a solid, liquid or gaseous material.

5. The method according to claim 4, in which for optical near-field microscopy the probe (2) and a sample (1) which is to be examined and which forms the associated second object of the object combination are moved step by step relative to each other, and in which method spatially resolved detection of the modified fraction (s) takes place.
6. The method according to one of claims 4 or 5, in which, for optical near-field microscopy, illumination of the object combination takes place with infrared radiation of different wavelengths, wherein in each case spectrally specific detection of scattered light occurs.
7. The method according to any one of claims 4 to 6, in which the fraction of the measured scattered light, which fraction has been modified by the near-field coupling, is subjected to spectral analysis.
8. The method according to claim 4, in which, for the purpose of reading out optically stored data, the probe (2) as a reading head is moved over a data carrier which forms the associated second object of the object combination, and detection of a data structure takes place, which data structure has been placed onto, impressed into, or arranged underneath the surface of the data carrier.
9. The method according to claim 5 or 8, in which the sample (1) or the data carrier comprises a topography-free surface which comprises structures with differences in the refractive index and with

characteristic dimensions which are smaller than 10 μm .

10. The method according to claim 1, in which the acquisition of the modified fraction (s) comprises resonant excitation of at least one adjacent object (1-7) of a polar material.
11. The method according to claim 10, in which with the acquisition of the modified fraction (s) at least one row of objects out of a multitude of objects (1-7) of a polar material is resonantly excited.
12. The method according to claim 11, in which with the acquisition of the modified fraction (s) several rows of objects (1-7) of a polar material can be resonantly excited, which rows are interconnected by means of at least one branch.
13. The method according to any one of claims 10 to 12, in which physical characteristics, in particular the crystal structure, band structure or charge carrier density of at least one object or of a surrounding of at least one object, are modulated with electromagnetic, electric or magnetic fields so that the dielectric characteristics of the object are changed and the modified fraction (s) of the scattered light which is scattered on the object is modulated accordingly.
14. The method according to claim 13, in which the physical characteristics of the respective object or of its surroundings are modified with high-frequency or low-frequency electromagnetic fields.

15. The method according to claims 12 and 13, in which the physical characteristics of an object which is arranged on a branch are modified.
16. The method according to claim 13, in which the modulation of the modified fraction (s) of the scattered light is detected and used as an optical switching signal or for near-field illumination of further object combinations.
17. The method according to any one of the preceding claims, in which the polar material comprises a III-V-, IV-IV- or II-VI-semiconductor.
18. The method according to any one of the preceding claims, in which the polar material comprises a ferroelectrical material (e.g. barium titanate), SiC, Si₃N₄, CaPO₃, CaCO₃ or SiO₂.
19. A method for infrared spectroscopic examination of a sample, which comprises several components or phases, in which the sample is subjected to scattered-light detection by means of a method according to any one of claims 2 to 7, 17 or 18, and the components or phases are acquired or analysed depending on the occurrence of specific phonon resonances.
20. A measuring arrangement for measuring the scattered light in the infrared spectral region, comprising:
 - an illumination device (10) for generating infrared radiation;
 - a probe device (20) which is arranged so as to be movable at some distance from a sample (1) or so as to be in a sample (1); and
 - a detector unit (30) with which the infrared radiation scattered on the probe device (20) is detectable,

characterised in that

- the probe device (20) comprises at least one probe (2) which at least partly comprises a material with a polar solid-state structure.
21. The measuring arrangement according to claim 20, in which the probe (2) comprises a III-V-, IV-IV- or II-VI-semiconductor.
 22. The measuring arrangement according to claim 20, in which the probe (2) comprises a ferroelectrical material (e.g. barium titanate), SiC, Si₃N₄, CaPO₃, CaCO₃ or SiO₂.
 23. The measuring arrangement according to any one of claims 20 to 22, which is designed as an optical near-field microscope with a scanning tip (21) which carries the probe (2), and a laser-detector combination (22) for controlling the position of the scanning tip (21).
 24. The measuring arrangement according to any one of claims 20 to 22, which is designed as a reading device for an optical data storage device.
 25. The measuring arrangement according to any one of claims 20 to 22, which is designed as a chemical or physical sensor device.
 26. An optical modulator (60) for acquiring or processing optical near-field interaction signals in the infrared spectral region, comprising:
 - at least two objects (1-7) which are arranged on a substrate (61); and
 - an illumination device (10) for illuminating the objects (1-7) with infrared radiation, wherein

- the distance between the objects (1-7) is so short that infrared-near coupling between the objects is produced as a result of radiation, characterised in that
 - at least one of the objects (1-7) consists at least in part of a material that has a polar solid-state structure; and
 - at least one of the objects (1, 2, 6) is connected to a modulator device (70) for the modulation of physical characteristics, in particular crystal structure, band structure or charge carrier density of the object, of which there is at least one, or of a surrounding of the object of which there is at least one with electromagnetic, electric or magnetic fields.
27. The optical modulator according to claim 26 which comprises at least one detector device (40) with which the infrared radiation scattered on the objects (1-7) is detectable.
28. The optical modulator according to one of claims 26 or 27, in which at least one row comprising a multitude of objects (1-7) of a polar material is provided, which objects, when at least one combination of two adjacent objects is illuminated, are mutually excitable so as to be resonant.
29. The optical modulator according to claim 28, in which several rows of objects (1-7) are provided which are interconnected by way of at least one branch.
30. The optical modulator according to any one of claims 26 to 29, in which the objects comprise a III-V-, IV-IV- or II-VI-semiconductor.

31. The optical modulator according to any one of claims 26 to 30, in which the objects comprise a ferroelectrical material (e.g. barium titanate), SiC, Si₃N₄, CaPO₃, CaCO₃ or SiO₂.
32. The optical modulator according to any one of claims 26 to 31 which forms an optical circuit.
33. The optical modulator according to any one of claims 26 to 32, in which the illumination device (10) and/or the detector device (40) are/is arranged on the substrate.